Catalog Course Description

Treatment of transformers, electromechanical transducers, rotating and linear electric machines. Lumped parameter electromechanics of interaction. Consideration of the basic machine types: dc, induction, synchronous. Development of device characteristics: energy conversion density, efficiency; and of system interaction characteristics, regulation, stability, controllability, and response.

This course is really about...

Electromechanics, with primary emphasis and applications to electric machinery. It teaches, at the level of graduate students, an understanding of principles and analysis of electromechanical systems. At the end of the subject the students will be able to do basic electromechanical design of the major classes of rotating electric machines, and will have an understanding of the principles of the energy conversion parts of Mechatronics. The approach taken is “classical” in the sense that it attempts to develop an understanding of the phenomena that are important. I’ll make an effort to utilize numerical methods as much as possible.

The course emphasis is on understanding phenomena and interactions. In addition to design, students will also learn how to estimate the dynamic parameters of electric machines and to understand what the implications of those parameters are on performance of systems incorporating those machines.

The examples and homework will be taken from current research at MSU and elsewhere.
Prerequisites

I expect the students have taken an introductory course in Power and/or Electric Machinery, and are familiar using Matlab and Simulink. Since the pace will be fast, any gaps in knowledge will have to be covered by the student.

Approach to teaching

I assume that the students are smart and self-motivated, require little hand-holding and know when to come in and ask for help. There are three hours of lecture per week and lectures move relatively fast. We make limited reference to a couple of books, but they are supplemented by notes. Heavy emphasis is placed on the homework, both for learning and for grading, with a mix of problems from textbooks and others suggested by current research. There will be two exams.

Instructor

E.G.Strangas, strangas@egr.msu.edu, Room EB1218. Office hours to be announced; make sure you see me very often.

Schedule

Lectures will be held twice a week, Tuesday and Thursday, 5-6:20, at 2245 Engineering Building

You will have two weeks to complete each homework assignment, and I expect that all will be delivered on time (one exception per student). I expect that you will start working on the homework immediately after it is assigned, and will have a short discussion at the end of the first week.
There will be two exams, counting together as much as homework.

**Topics**

- Fundamental electromagnetics (forces and energy, Faraday’s law, Maxwell stress tensor, Poynting vector),
- Fundamentals of devices, energy and coenergy, multiply excited systems, eddy currents, magnetic circuits,
- Simple models of synchronous machine, p.u. system,
- Windings,
- Permanent magnet AC machines, operation parameters, design concepts,
- Induction machines,
- Switched Reluctance Machines.

**Textbooks**

There is no single textbook for the subject. We will use this semester the notes for a similar course at MIT, taught by Professor Kirtley, and the book by Professor T. Lipo. All these will be augmented by papers and notes.

Prof. Kirtley’s notes contain most everything that is important, and the book by Prof. Lipo a lot of useful analysis and excellent reference.


There are books that can be of interest and useful for future reference:

The book is useful for background, has some good explanations and pictures of machines. It is, however, not very analytical.

3. Strangas, E.G. *Notes for an Introductory Course on Electrical Machines and Drives*. 

These are the class notes for ECE320, an abbreviated version of the course material, available for downloading from the class web site.


Excellent text and reference.


Not really a handbook but not yet a textbook, this shows some of the analytical techniques we will be using. It is a bit more finished than the class notes but does not contain a lot of material beyond them.


Although this book does not discuss the design of electromechanical systems, it is useful in developing and understanding models.
